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Flavor and Slaw Cut Quality Evaluation of Fresh Market Cabbage in 2000

Information on the Effects of Planting Date and Genotype on Fresh Market Cabbage Flavor and Slaw Cut Quality in Ohio in 2000

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Abbott and Cobb
American Takii
Asgrow Seeds
Bejo
d. Palmer
Harris Moran
Orsetti
Reed's Seed
Sakata
Vilmorin, Inc.

Project Summary

The primary goal of these studies was to develop information useful to Ohio growers in selecting varieties, especially for different planting periods. These studies were also designed to help explain how the interaction between genotype and growing environment impacts specific crop traits, including flavor and slaw cut quality.

To accomplish these goals, we transplanted twenty-four fresh market cabbage varieties and experimental lines in fully replicated plots on May 12 and June 30, 2000 at the Vegetable Crops Research Branch in Fremont, Ohio. Yield and physical external and internal head traits were recorded at harvest. Samples were also submitted to The OSU Food Industries Center for flavor and slaw cut quality evaluation. Results from these quality evaluations are presented in this report. Yield, head trait, and other data are summarized in Horticulture and Crop Science Series Report #705 (January 2001), available in print and on the Internet (see p. 5).

Materials and Methods

Transplant Production. Entries were solicited from cooperating seed companies in winter 1999-2000 (Table 2). Transplants were seeded in early spring, allowed to develop 2-4 true leaves in the greenhouse, and hardened-off before planting into the field.

Plot Establishment. Twenty-four varieties and experimental lines of fresh market cabbage were planted on May 12 and June 30, 2000 at the Vegetable Crops Research Branch in Fremont, OH. Plots of each entry were replicated four times per planting date and arranged in randomized complete block design, including planting date as a replication and design factor. Transplants were set into two-row plots established with a cone-type transplanter. Each row was 15 ft. long (each row containing approx. 16 plants), with 30 in. between rows and 11 in. between transplants. A 0-46-0 fertilizer was used to supply 60 lb. P_2O_5 and a 0-0-60 fertilizer was used to supply 250 lb. K_2O in September 1999. Ammonium nitrate was broadcast to supply 70 lb N/A on May 5, 2000. A nutrient starter solution (0.7 qt. 10-34-0/50 gal. water) was delivered next to the transplants.

Plot Maintenance. Dead transplants were replaced (if possible) within one week of initial planting. Standard pest management strategies based on scouting, thresholds, and application of labeled pesticides were employed.

Data Collection (Field). Plots were reviewed twice per week to assess development. Notes on plant stature, head shape, and other traits were taken on mature entries immediately prior to harvest.

Data Collection (at Harvest). Data Collection (at Harvest). Harvest readiness for individual entries was estimated from published maturity information and visual examination of each of the four plots. At maturity, all heads were collected from within the center 10 ft. of both rows in each plot. Heads were scored as marketable or unmarketable (too small, split, rotten, or containing evidence of blackrot or tipburn) and weighed as a group. Ten marketable heads were then selected at random from the harvested group for further evaluation. Five outer leaves were removed from each head before they were re-weighed individually. Heads were then cut in half longitudinally and the core length and base width as well as the head polar and equatorial diameter of each head recorded. All data referred to in this section are summarized in the Horticulture and Crop Science Series Report #705 (January 2001), available in print and on the Internet (see p. 5).

Flavor and Slaw Cut Quality Evaluation at The OSU Food Industries Center. To our knowledge, no acceptable scientific protocol exists for the large-scale evaluation of cabbage flavor and slaw cut quality. In this project, our goals were to establish a preliminary evaluation protocol and provide reliable estimates of post-harvest quality on numerous genotypes grown under varying environmental conditions.

Two heads remaining from the ten-head group collected at harvest from each plot were immediately placed in refrigerated storage until evaluation at The OSU Food Industries Center, typically within ten days after harvest. Samples were identified with numbers only as evaluators had no knowledge of the entries under study. At the Food Industries Center, heads were trimmed, cut, tasted, and assessed for slaw cut quality by the Director and staff of the Center and Ted Radovich. Slaw cut quality was estimated by hand-chopping several heads followed by hand examination of tissue thickness and texture. The desired cut was considered to contain crisp, moderately thick, short-medium length sections.

Evaluators then tasted cut tissue and recorded their taste sensations. Sensations and their associated connotations are listed below.

Table 1. Cabbage flavor sensations and their associated connotations.

Flavor sensation and associated connotation		
negative (-)	neutral (0)	positive (+)
astringent	fair	good
atypical	strong[1]	light
bitter	sweet	mild
cloying[2]		typical
earthy		
grassy		
hot		
musty		
off-flavored		
residual flavor		
sulfur		

[1] strong was used in association with both negative and positive sensations
[2] cloying = sickly sweet, aromatic

Notes taken at evaluation were later reviewed and used to formulate the overall desirability ratings shown in Tables 4-6. Individual comments with negative, neutral, or positive connotations were tallied for each sample. And, each genotype was assigned an overall desirability rating (undesirable (-), neutral (0), or desirable (+)) based on the majority of connotations compiled from individual samples. For example, if "good cabbage flavor" (with a positive connotation) was noted in three samples and "hot" (with a negative connotation) noted in one sample, the genotype was assigned a positive overall desirability rating. A neutral rating was assigned when a similar number of positive and negative connotations was tallied.

Results

Results are shown in Tables 4-6. Table 4 contains overall desirability ratings (-, 0, +) for flavor and slaw cut quality, derived from written comments made at evaluation (see Tables 5 and 6). For each genotype, the range of comments made about it are listed in Table 4. Overall desirability ratings for each genotype, though, were based on the frequency of comments with negative, neutral, or positive connotations.

Interpretation

Diverse markets, the need for sequential plantings, and the importance of quality in the marketplace complicate variety selection in fresh market cabbage production. Genotype and management (e.g., planting date selection) impact raw product quality, including flavor and slaw cut quality. Research-based information on how a variety responds to changes in planting date, for example, may assist growers in identifying varieties largely uneffected by planting date or in selecting varieties specifically for early or late planting.

In 1999, we initiated studies to identify and explain the contribution of genotype and planting date to fresh market cabbage flavor and slaw cut quality. Unfortunately, an acceptable scientific protocol for the large-scale evaluation of cabbage flavor and slaw cut quality is not available. In this and a previous related report (Horticulture and Crop Science Series Report #702 February 2000), we have established a preliminary protocol for obtaining and reporting estimates of cabbage flavor and slaw cut quality. In addition to employing "blind" evaluations of samples taken from replicated field plots, the protocol is characterized by: (a) assignment of negative, neutral, or positive connotations to quality indicators, (b) tabulation of connotations, and (c) assignment of an overall desirability rating (undesirable, neutral, desirable) based on tabulated connotations. Therefore, the protocol establishes a preliminary mechanism to quantify subjective assessments of quality.

Under 2000 experimental conditions, flavor was impacted by genotype and planting date. Flavor desirability ratings in Table 4 differed among genotypes within both plantings (May 12, June 30). And, the number of genotypes with an undesirable, neutral or desirable rating changed from the May 12 to June 30 planting. More important, flavor desirability ratings changed with planting dates in thirteen of nineteen genotypes rated. Ratings of nine genotypes improved with summer planting while ratings of four genotypes were reduced with summer planting. Two varieties (Matsumo, Primero) had ratings of "undesirable" in the spring planting but "desirable" in the summer planting.

The 2000 season was characterized by below average temperatures and above average rainfall (Table 3). Above average rainfall was recorded in nearly all phases of crop development, especially during all stages of the spring planting and later stages of the summer planting. Climatic conditions and small variations in harvest-evaluation intervals may have impacted desirability ratings. Additional efforts to refine the evaluation protocol are underway. For example, direct measures of leaf thickness and texture and mechanized chopping are being explored.

For more information on this report or to receive copies of this or similar publications, please contact:

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Table 2. Number of days to harvest (DTH) for twenty-four genotypes of fresh market cabbage planted on May 12 and June 30, 2000 at the OSU Vegetable Crops Research Branch in Fremont, OH.

Entry			May 12	June 30
Name	#	Company	DTH	DTH
Arena	1	Sakata	123	131
Blue Dynasty	2	Asgrow Seeds	95	87
Blue Lagoon F1	3	Harris Moran	84	87
Blue Thunder F1	4	Harris Moran	110	104
Blue Vantage	5	Sakata	95	87
Bronco	6	Bejo	119	122
Cheers	7	American Takii	110	104
Emblem	8	Sakata	95	87
Green Cup	9	American Takii	110	104
HMX 0225	10	Harris Moran	119	131
HMX 0228 F1	11	Harris Moran	95	104
Matsumo	12	Bejo	110	104
Solid Blue # 780	13	Abbott & Cobb	119	122
Solid Blue # 790	14	Abbott & Cobb	110	122
SuperElite Hybrid	15	Reed's Seed	119	122
XP 5210157	16	Asgrow Seeds	84	104
XP 5210387	17	Asgrow Seeds	95	104
DPSX 308	18	d. Palmer	95	87
DPSX 309	19	d. Palmer	110	104
DPSX 315	20	d. Palmer	95	87
DPSX 327	21	d. Palmer	110	122
Red Dynasty	22	d. Palmer	95	87
Primero	23	Bejo	80	87
Red Success	24	Orsetti	84	87

Table 3. Climatic data for fresh market and processing cabbage studies planted at the OSU Vegetable Crops Research Branch in Fremont, OH in 2000.

	-- Avg. Temp (F) -		-------Precipitation (in.)-------		
	High	Low	Actual	Normal	-/+ Normal
Fresh Market Study					
Planting 1 (May 12)					
May 12 - June 6 (25 d)	71.2	50.8	4.62	3.5	1.12
June 7 - July 27 (50 d)	80.3	59.2	7.76	6.5	1.26
July 28 - Aug. 22 (25 d)	79.3	59.2	4.98	3.0	1.98
Total			17.36	13.0	4.36
Planting 2 (June 30)					
June 30 - July 24 (25 d)	79.4	58.1	1.38	3.3	-1.92
July 25 - Sept. 12 (50 d)	80.1	59.1	7.20	5.1	2.10
Sept. 13 - Oct. 7 (25 d)	70.5	46.3	4.40	2.5	1.90
Total			12.98	10.9	2.08
Processing Study					
Planting 1 (May 15)					
May 15 - June 9 (25 d)	71.2	51.3	4.58	3.6	0.98
June 10 - July 30 (50 d)	80.8	59.7	10.11	6.4	3.71
July 31 - Aug. 25 (25 d)	78.8	58.2	2.75	2.8	-0.05
Total			17.44	12.8	4.64
Planting 2 (July 6)					
July 6 - July 31 (25 d)	80.0	58.5	3.14	2.9	0.24
Aug. 1 - Sept. 20 (50 d)	78.7	56.9	4.83	5.5	-0.67
Sept. 21 - Oct. 15 (25 d)	67.2	43.5	4.19	2.2	1.99
Total			12.16	10.6	1.56

Table 4. Summary of head physical and sensory evaluation for twenty-four genotypes of fresh market cabbage planted on May 12 and June 30, 2000 at the OSU Vegetable Crops Research Branch in Fremont, OH. The flavor and slaw cut quality of mature heads were rated as undesirable (-), neutral (0), or desirable (+) based on notes taken during evaluation at the OSU Food Industries Center. Blank spaces indicate that the genotype was not evaluated.

	----------Flavor----------		---------Slaw Cut---------	
Genotype	May 12	June 30	May12	June 30
Arena		-		
Blue Dynasty	-	0	+	0
Blue Lagoon	-	0	+	+
Blue Thunder	0	0	-	
Blue Vantage	-	0	-	-
Bronco		0		
Cheers	+	-	+	
DPSX 308	-	0	0	0
DPSX 309	0	+	+	
DPSX 315	0	+	0	0
DPSX 327	0	0	0	
Emblem	0	0	-	-
Green Cup	+	0	0	
HMX 0225		-		
HMX 0228	+	0	+	
Matsumo	-	+	0	
Primero	-	+	-	+
Red Dynasty	0	0	+	-
Red Success	+	+	-	+
Solid Blue 780		0		
Solid Blue 790	0	+	0	
SuperElite Hybrid		-		
XP 5210387	0	0	+	
XP5210157	+	0	0	
Number evaluated	19	24	19	9
Number undesirable (-)	6	4	5	3
Number neutral (0)	8	14	6	3
Number desirable (+)	5	6	8	3

Table 5. Sensory evaluation for twenty-four genotypes of fresh market cabbage planted on May 12 and June 30, 2000 at the OSU Vegetable Crops Research Branch in Fremont, OH. The flavor of leaves taken from mature heads was assessed at the OSU Food Industries Center. Based on the comments shown, the overall flavor of the genotype was rated as undesirable (-), neutral (0) or desirable (+). Blank spaces indicate that a variety was not evaluated.

Planting Date and Genotype	Comments Made at Evaluation	Overall Desirability Rating
May 12, 2000		
Blue Dynasty	Mild, bitter, some earthy or musty flavor	-
Blue Lagoon	Mild, some sweetness, some residual off-flavor, slightly hot	-
Blue Thunder	Generally mild, good flavor, but some bitterness noted	0
Blue Vantage	Mild, but atypical cabbage flavor, grassy	0
Cheers	Mild, good cabbage flavor with some sweetness	+
DPSX 308	Mild, some good cabbage flavor, slightly hot, musty	-
DPSX 309	Mild with some sweetness and atypical cabbage flavor	0
DPSX 315	Good cabbage flavor, slightly hot	0
DPSX 327	Mild, good, sweet, slightly hot, some atypical flavor	0
Emblem	Mild, some bitterness and sweetness, slightly hot	0
Green Cup	Mild, sweet, good cabbage flavor	+
HMX 0228	Mild, sweet, good cabbage flavor, slightly hot	+
Matsumo	Mild, fair flavor, slightly hot with some residual off-flavor	-
Primero	Some good, but some hot, off-flavored or astringent	-
Red Dynasty	Generally good, mild, but some atypical cabbage flavor	0
Red Success	Mild, good cabbage flavor with some sweetness	+
Solid Blue 790	Very mild, with some sweetness and atypical cabbage flavor	0
XP 5210387	Mild, with good cabbage flavor, some bitterness	0
XP5210157	Generally mild with some sweetness	+
June 30, 2000		0
Arena	Strong, bitter, cloying, slightly hot, some sulfur off-flavor	-
Blue Dynasty	Mild with some musty flavor	0
Blue Lagoon	Mild flavor, slightly hot	0
Blue Thunder	Mild to strong flavor with some sweetness, slightly hot	0
Blue Vantage	Some good, some with musty or earthy off-flavors	0
Bronco	Sweet, light, bitter	0
Cheers	Hot, strong flavor with some sweetness	-
DPSX 309	Sweet, strong, slightly hot	0
DPSX 315	Mild, good, typical cabbage flavor	+
DPSX 327	Strong, sweet, good cabbage flavor	+
DSPX 308	Mild, slightly sweet with some grassy flavor	0
Emblem	Mild, some sweetness, slightly hot	0
Green Cup	Some good, but some bitter, cloying, slightly hot	0
HMX 0225	Strong, bitter, hot, some sulfur off-flavor	-
HMX 0228	Sweet, good cabbage flavor, some slightly hot	0
Matsumo	Sweet, good cabbage flavor	+
Primero	Mild	+
Red Dynasty	Mild with some musty flavor	0
Red Success	Good, mild cabbage flavor with some sweetness	+
Solid Blue 780	Sweet, slightly hot	0
Solid Blue 790	Good, mild to strong, sweet flavor	+
SuperElite Hybrid	Mild to strong flavor, cloying, sweet, slightly hot	-
XP 5210157	Strong, sweet, slightly hot	0
XP 5210387	Good cabbage flavor, mild, slightly hot	0

Table 6. Physical evaluation of nineteen genotypes of fresh market cabbage planted on May 12 and June 30, 2000 at the OSU Vegetable Crops Research Branch in Fremont, OH. The quality of a slaw cut was assessed at the OSU Food Industries Center. Based on the comments shown, the overall quality of the slaw cut was rated as undesirable (-), neutral (0) or desirable (+). Blank spaces indicate that the genotype was not evaluated.

	Planting Date and Slaw Cut Assessment	
Genotype	May 12	June 30
Blue Dynasty	Good, crisp, some large leaves (+)	Fine to rough, crisp to mushy (0)
Blue Lagoon	Straight cut, small leaf, good texture (+)	Good cut, crisp (+)
Blue Thunder	Tough, some large leaves (-)	
Blue Vantage	Large leaves, crisp to soft texture (-)	Rough cut, soft, mushy (-)
Cheers	Good slaw quality, some large leaves (+)	
DPSX 308	Crisp, large leaves, fine to rough cut (0)	Good cut, crisp, some softness (0)
DPSX 309	Good quality, crisp, fine (+)	
DPSX 315	Large leaves and core, firm, crisp (0)	Good cut, some large leaves (0)
DPSX 327	Rough cut, crisp (0)	
Emblem	Large leaves, rough cut (-)	Rough cut, crisp to spongy (-)
Green Cup	Good cut, slightly tough (0)	
HMX 0228	Crisp, fine (+)	
Matsumo	Rough cut, crisp (0)	
Primero	Large leaves, undesirable (-)	Crisp (+)
Red Dynasty	Crisp, some large leaves, good slaw (+)	Large leaves, undesirable (-)
Red Success	Large leaves, soft, fine to rough cut (-)	Crisp (+)
Solid Blue 790	Rough cut, tender to mushy (0)	
XP 5210387	Crisp, good cut, some large leaves (+)	
XP5210157	Good texture, large leaves, cores (0)	
Number evaluated	19	9
Number undesirable (-)	5	3
Number neutral (0)	6	3
Number desirable (+)	8	3

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